Asian Society of
Agricultural Economists

8th International Conference

VIABILITY OF SMALL FARMERS IN ASIA

15-17th October 2014 Savar, Bangladesh

Organized session 5

Targeting of Grain Legumes for Income and Nutritional Security in South Asia

16th October 13.30 to 15.30

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Targeting and introduction of Chickpea improved cultivars in Bihar state of India

Tropical Legumes II Phase 2 Project

Meera Kumari, Madhu Bhattarai, Rakesh Kumar, D Moses Shyam and P Jyosthnaa

Bihar Agricultural University (BAU), Sabour

International Crops Research Institute for the Semi-Arid Tropics

2014

Targeting and introduction of Chickpea improved cultivars in Bihar state of India

Meera Kumari[1], Madhusudan Bhattarai, Rakesh Kumar,D Moses Shyam,and P Jyosthnaa

ABSTRACT

Chickpea is one of the major pulses in Bihar, with crop yield of 1000 kg/ha, which is higher than the national average of crop yield (841 kg/ha). Despite of huge potential and comparative advantage, the crop acreage and production of chickpea in Bihar has been in declining trend. Lack of availability of seed of improved varieties, problems in marketing the produces, and insecurity and/or widespread theft of crop from the field are some of the prominent reasons. A base line survey was conducted in selected eight villages in two districts of Bihar, which was with an aim of increasing the area and production of chickpea through adoption and diffusion of improved crop varieties. This was also associated with improved management practices in target districts of Bihar. The objective of this socio-economic study on chickpeas was to appraise the existing situation of production and marketing of chickpeas in selected districts/villages of Bihar, and with respect to adoption of alternate technologies, and its impacts on crop productivity. This includes also estimation of farmers' profitability in growing the crop. This is based on survey of sample of 135 farmers from each of the two districts; which were further divided into control and treatment groups. In 2012/13, the average yield of improved variety in adopted villages was 9.5 quintal /ha and the yield of local variety was 8.5 q/ha. The per capita income of farmers in the adopted village was more than that of control village, even though only about 54% of total household income was derived from the crop enterprise. However, the chickpea alone contributes to about Rs 9000 to 15000 per ha in the sample villages surveyed. Our study also suggests that chickpeas have a comparative advantage in Bihar than several other crops; and they are financially highly profitable in the study sites. Data pertaining to preferred traits for production, consumption and marketing indicated that those introduced varieties have been given higher yield, having better taste along with good keeping, and with better cooking quality, followed by fetching high price in the market are most preferred by all the respondents of study. Involvement of women in chickpeas production is very high, especially for harvesting and threshing activities. Major constraints in cultivation of chickpeas in the studied sites are high pod borer incidence, shortage of seed of HYV, lack of crop type suitable for flood receding agro-ecology, and lack of marketing infrastructures and storage of crops after harvest

***Key words**: chickpeas, Bihar, Bhagalpur; Banka, socio-economic analyses, production constraints*

[1] Economist, BAU, Sabour. Corresponding author email: meera.bausabour@gmail.com

1. Introduction

Chickpea is one of the major pulses in Bihar, with crop yield of 1000 kg/ha, which is higher than the national average of crop yield (841 kg/ha). Despite of huge potential and comparative advantage, the crop acreage and production of chickpea in Bihar has been in declining trend. In this study, we assess the present socioeconomic condition of production of chickpeas in this state of Bihar, and farmers' constraints and opportunities in production and marketing of Chickpeas in Bihar. This is done based on primary survey in 8 villages in two districts of southern and eastern Bihar, that is in Bhagalpur and Banka district of Bihar.

Chickpea crop areas and production have increasing trend in India during the last 10 years, the crop acreage in India has increased by over 20% during the last one decade, with an over 8.75 million ha of acreage in 2010 (DES, Govt. of India, 2012). Not only crop acreage, but also crop yield, and total production have also increased during the same period. The increased on crop production is more in states like Maharashtra, M.P., Rajasthan, Andhra Pradesh, Karnataka and Gujarat (Table 1) than other states of India.

Table.1 Grouping of states by increasing and decreasing trend of chickpeas acreage

State	Area	Production
Sates where Area and Production of chickpea is in increasing trend	Andhra Pradesh	Andhra Pradesh
	Karnataka	Karnataka
	Madhya Pradesh	Madhya Pradesh
	Maharashtra	Maharashtra
Sates where Area and Production is in decreasing trend	Assam	Assam
	Bihar	Bihar
	Haryana	Haryana
	Punjab	Punjab
	Uttar Pradesh	Uttar Pradesh
	Himachal Pradesh	Himachal Pradesh
	Orissa	Orissa

Note: Some of states presented in Table 1 are denoted as losing state with respect to area and production (Fertilizer News 2012, Govt. of India).The assessment data by each state suggest that Gujarat state followed by Maharashtra recorded highest growth in crop yield, likewise, instability on crop acreage and yield was recorded highest in Rajasthan followed by Maharashtra and Haryana.

Likewise, assessment of the crop acreage trend by states reveal that there has been a gradual shift in crop acreage across the states in India, and the crop acreage has sharply declined in states like Punjab and other northern states, but during the same period, the crop acreage has been increased in southern India states like Andhra Pradesh.

Study objectives

The main purpose of the study is to assess socioeconomic aspects of chickpeas growers in Bihar state, in relation to a project on adoption and dissemination of improved cultivar of chickpeas in selected parts of Bihar. Keeping in the view of this context, the study has following specific objectives:

1) To carry out socioeconomic assessment of chickpeas cultivation in selected districts of Bihar;
2) To assess farmers level constraints and opportunities in cultivation of chickpeas in the study areas;
3) To identify and evaluate farmers' preferences over different traits of chickpeas
4) To assess gender roles and functions in cultivation of chickpeas in the study sites; and
5) To suggest policy implications on constraints and opportunities of chickpeas production in the study sites

With this background, the paper has been structured following way. The second chapter describes chickpeas production in Bihar state, its overall historical trend, and production status in the districts selected for the field study. Then, the third

2. Chickpea production in Bihar

In Bihar, agriculture sector has experienced a considerable growth during the past three decades. The progress has been spectacular in 1980's when state recorded agriculture growth of 2.50 percent per annum, which has been however could not been sustained during nineties. This same pace of growth is not there in pulses and other minor crops, for example, Pulse crops got major setback; the total pulse crop acreage has declined from 1.63 million ha in 1970-71 to 0.53million ha in the year 2011-12. Some part of this declined is also due to bifurcation of state in early 2002; however, within the present days Bihar state, there has been continues declining on crop acreage and production of pulses.

Moreover, about 520 thousand metric tons of pulse was produced in the state in 2011-12, which is about 4% of total production of pulse in the country. The percentage area under pulses to gross cropped area has in declining trend in Bihar, especially in the region where gross irrigated area expanded (Chopra, 1982). Considering rising demand of pulses in the country, and Bihar a traditionally pulse production belt of India, this is an alarming situation. Among pulse crops grown in Bihar, only crop acreage of Lentil has increased recently, with crop acreage of about 20,000 hectares in 2010. Likewise, the crop yield (991kg/ha)of Lentil is also higher in Bihar than that of the all India level average.

Area under pulses has experienced not only a declining trend, but also pulse acreage was most instable during the last two and half decades. However, variability of crop area of total pulse is comparatively lower, however, in case of individual pulse crops; chickpea has highest variability in area and production; whereas productivity of lentil shows lowest variability. Consultation with farmers reveals that rainfall during late kharif season has positive impact on increase in pulse area in the state. In case of Bihar, the crop yield has increased from 550 kg/ha in 1975/76 to 1000 kg/ha, in 2010-11, however, the chickpeas acreage cannot be compared for Bihar for the same period due to bifurcation of the state in early 2000. Even after 2003, after bifurcation of the state of Bihar, the chickpea area has been in declining trend in the new state of Bihar, due to profitability and growing popularity (and public policy emphases) on Rice-Wheat system and other competing cropping patterns. It has been noticed that as irrigation facilities developed, chickpea crop area in the state gradually has been converted to rice and wheat system (also confirmed in authors' discussion with the farmers group in visit to site Sept 2013). There is a huge variability in area and production of chickpeas from 2000 to 2009; however, the productivity during the same period is more stable. This

indicates that there is a scope to increase production potential of chickpea in the state if the state government adopts adequate policy measures.

Table 2. Dynamics of changes on annual crop area, production, and yield of chickpeas in Bihar

Period	Annual average crop area(in 1000 ha)	Annual average Production (in 1000 tons)	Average Productivity (kg/ha)
Mean			
1990-2000	130.94	117.41	893.07
2000-2009	70.35	65.81	933.11
1990-2009	100.65	91.61	913.09
CV (Raw data)			
1990-2000	13.44	23.02	15.96
2000-2009	23.46	25.60	7.8
1990-2009	35.06	37.52	12.23

Chickpeas production in the districts selected for the study

For this study, two leading chickpeas production districts of Bihar were selected for farmer's level survey, therefore, a brief description on area and production of chickpeas and general feature of farming in the two districts are provided below:

Bhagalpur

In Bhagalpur district, the average area under chickpea in triennium ending 2000 was 5,042 hectare producing 4,416 tons with productivity of crop yield of 872 kg per hectare. It is endowed with congenial climate condition for cultivation of wide varieties of crops and trees. However, the periodic distribution of rainfall during the season is not uniform. Dry and wet spell are commonly experienced resulting in water stress. Rice is still a most important crop, which covered 41 to 46 percent of gross cropped area, but area under rice has also been declined now. However, area under maize has increased due to adoption of winter maize at large scale especially in Bihpur subdivision of Bhagalpur districts. Wheat is the main competing crop during the post rainy season followed by chickpea and oilseed crops. Relative importance of pulses in the districts is 23.09 percent of total gross cropped area. Among pulses chickpea accounts 60 percent of area to total pulses area in the districts. Since the last triennium ending, the area under chickpea has been increased but average productivity declined from 872 kg/ha to 744 kg/ha (2000-2009).

Banka

Banka is also located in Zone-3A having same climatic condition, rainfall but irrigation structure is different from Bhagalpur. Chickpea is one of the major pulse crops in Banka district with an area of 3873ha during 2000 after that it has declined to 2477ha until 2009 triennium ending however, average production has been stagnated over the same period. However, productivity level has shown an increasing trend as rises from716 kg/ha to1057 kg/ha. Wheat is the main competing crop during the post rainy season followed by chickpea and oilseed crops. Relative importance of chickpea to total cropped area is about 14 percent and average productivity across all other major crop is

comparatively higher than Bhagalpur. However, 90% of farmers continue to use local variety for chickpea cultivation.

Among selected sample district, the variability in area and production was found more in Bhagalpur as indicated by having higher CV value. However, Productivity was found less stable in Banka as indicated by having higher value.

Table 3: Crop area, production and yield of chickpeas in two districts in Bihar and instability (1997 to 2012).

Year	Bhagalpur			Banka		
	Area (ha)	Production (t)	Yield (kg/ha)	Area (ha)	Production (t)	Yield (kg/ha)
1997-2000	5042	4416	872	3873	2703	-716
2003	3619	3012	823	3008	1836	745
2006	3144	2126	663	3561	2680	745
2009	6162	4619	744	2477	2783	1057
Instability measure (CV)						
Raw data						
1997-2000	0.23	0.02	0.14	0.03	0.05	0.22
2000-2003	0.23	0.02	0.1	0.04	0.04	0.01
2003-2006	0.24	0.02	0.09	0.03	0.05	0.18
2006-2009	0.85	0.03	0.19	0.05	0.09	0.18
De-trended Data						
1997-2000	0.01	0.02	0.14	0.03	0.05	0.22
2000-2003	0.02	0.02	0.1	0.04	0.04	0.1
2003-2006	0.03	0.02	0.09	0.03	0.05	0.18
2006-2009	0.02	0.03	0.19	0.05	0.09	0.18

3 Field study sites and insights from the survey

Cropping patterns and major crop varieties in the study area

Major crops grown in the studied districts are presented in Table 4.Chickpea, lentil and wheat, are the major Rabi crops grown in the region. Data clearly indicates that in adopted village of Bhagalpur district, wheat was the major Rabi crop followed by chickpea. On the contrary in control villages where chickpea was the major Rabi crop followed by wheat (0.06 ha/household). At Banka, the major Rabi crop was chickpea (0.58 ha/household) followed by Wheat and Mustard in their cropping patterns. Major crops cultivated in the study districts are presented in Table 5.

In summary, average cropping pattern across study districts indicated that cereal crop dominates the cropping pattern in the state followed by pulses. Among the pulses, chickpea and lentil are the two major crops cultivated in both the districts surveyed.

Table 4. Average cropping patterns across study districts (% of crop area)

Kharif (Rainy season)

Crops	Bhagalpur		Banka		Pooled	
	Adopted	Control	Adopted	Control	Adopted	Control
Paddy	0.61	0.28	0.78	0.71	0.695	0.495
Maize	0	0.06	0.01	0	0.005	0.03

Post rainy (Rabi)

Crops	Bhagalpur		Banka		Pooled	
	Adopted	Control	Adopted	Control	Adopted	Control
Chickpea	0.66	0.36	0.50	0.48	0.58	0.42
Wheat	2.31	0.06	0.42	0.29	1.365	0.175
Mustard	0.55	0	0	0	0.275	0
Lentil	0	0.01	0.02	0.004	0.01	0.007

Summer

Crops	Bhagalpur		Banka		Pooled	
	Adopted	Control	Adopted	Control	Adopted	Control
Maize	0.01	0.18	0.13	0.13	0.07	0.155
Mung	0.004	0.24	0.10	0.07	0.052	0.155

Relative importance of chickpea crop in cropped area of Bihar sample, 2011-12

The relative importance of chickpea crop in total cropped area is shown in Table 5. Chickpea was accounted nearly about 20 per cent in adopted village and to 36 percent in control village s respectively.

Table 5. Land allocation for growing chickpeas in the study sites in Bihar

Cropped area	Bhagalpur		Banka		Pooled Sample	
	A	C	A	C	A	C
Rainy season cropped area (ha)	55.6	16.4	73.5	32.2	129.1	48.5
Post rainy season cropped area (ha)	321.4	20.1	82.9	36.8	404.3	56.9
Area under post- rainy season chickpea area post rainy area (ha)	60.1	16.5	45.9	21.9	106.1	38.4
Proportion of chickpea area to total cropped area (%)	16	45	29	32	20	36
A: Adopted village; C: Control village						

Productivity of major crops

Average productivity of major crops such as wheat, and chickpea was comparatively higher in Banka than that of Bhagalpur district (Table 6). Average Yield of chickpea in adopted villages were comparatively higher (754.5kg/ha) than control village (689kg/ha) as indicated in Table 6.Crop yield

of some other crops like paddy, mung and lentil were also higher in control villages than that of the adopted.

Table 6: Average productivity levels across major crops (Kg per ha)

Crops	Season (K/R/S)	Bhagalpur		Banka		Pooled	
		Adopted	Control	Adopted	Control	Adopted	Control
Chickpea	R	711	616	798	762	754.5	689
Mustard	R	630	0	0	0	315	0
Wheat	R	2408	2250	3440	2503	2914	2376.5
Paddy	K	2238	4006	3210	1979	2724	2992.5
Maize	K	0	4183	3593	0	1796.5	2091.5
Maize	S	2499	3618	3624	2118	3061.5	2868
Mung	S	624.5	1206	840	1666	792.25	1436
Lentil	R	0	1000	704	1000	352	1000

However, data pertaining to composition of different varieties indicated that traditional variety still playing an important role in their chickpea cropped area. Local varieties accounted nearly 90-95 percent of total chickpea area cultivated in the surveyed sites (Table-7). Among traditional verities cultivated, *Desla Plain* was accounting about 69% in adopted villages and 47% in control villages respectively followed by *Desla Roon* and Radha. Among improved cultivars of chickpeas, JG 14 was accounted highest share, i.e., 2.3% followed by KAK 2 (2.1%) on the plot areas of the sample farmers surveyed.

Deshla plain is popular variety which is generally used by many of the farmers (49.2 ha) in the adopted villages of Bhagalpur followed by 23.3 ha in Banka district. However, its share was much less in control village of Banka than other places.

Table 7. Crop acreage by variety grown (%)

Variety	Bhagalpur		Banka		Pooled Sample	
	Adopted	Control	Adopted	Control	Adopted	Control
DESLA PLAIN	81.70	96.90	51.80	9.70	68.80	47.10
DESHLAROON	6.90	1.20	32.50	68.20	17.90	39.50
JG 14	0.10	0.00	5.20	0.00	2.30	0.00
KAK 2	0.70	0.00	4.00	0.00	2.10	0.00
Radha	1.00	1.90	6.30	14.70	3.30	9.20
Subhara	1.50	0.00	0.20	7.40	1.00	4.20
Vaibhav	8.10	0.00	0.00	0.00	4.60	0.00
Sub-total	100	100	100	100	100	100
Total area	60.2	16.5	45.0	22.0	105.2	38.5

4. Study framework and methodology

4.1 Sampling framework

The target districts and communities for conducting baseline survey on "chickpea cultivation in Bihar" under TL-II project was mainly based on the technology intervention (PVST of chickpea on farmer field) under the collaborative efforts of ICRISAT and Bihar Agricultural University (BAU), Sabour during the year 2010-11. In this regard, two districts of Bihar were selected purposively for the socioeconomic analyses. These two districts are also the project target districts where breeders and other scientists of the project have a plan to disseminate the improved variety of chickpeas more widespread in the near future; and also have distributed improved variety of chickpeas seed to over 100 farmers in the previous years.

In each district a cluster of 3 villages from two different blocks were selected as adopted villages and 3 villages from surrounding areas with comparable agro ecological and market condition were chosen to serve as control villages. Selection of control village would enable the team to do a comparable counter factual analysis in impact evaluation. In total, a cluster of three villages each from adopted and control villages i.e.,six villages in each district were identified for conducting base line survey.

The Two districts selected for the study are: Banka and Bhagalpur. The, three villages each from Bhagalpur districts i.e., Khankitta, Rajpur, and Pipra, were selected as adopted; and the control villages in the district were: Kurpat, Lailakh, and Jicho. The adopted villages were relatively close to Bihar Agricultural University, Sabour or research station.The adopted villages in the Banka district were Kotwal, Kotwali, and Simaria, and the villages those served as control were Gurudwara, Padampur and Babura.

To select households for the survey, stratified Random Sampling technique based on probability proportion to size method to farm size was used for selection of farmers. From each of the adopted villages a sample of 30 farmers were interviewed and from each control villages a sample of 15 farmers were interviewed. Thus, 135 from each district totaling to 270 farmers were interviewed. In this way a total of 180 beneficiaries from the six adopted villages to whom the technology was provided and 90 non-beneficiaries from the control village to whom the technology was not provided were randomly selected and surveyed. The detailed sampling framework is shown below.

Table 8.Selection of sample among selected districts and the study sites

District	Treatment/ Adopted village	No. of farmers	Control village	No. of farmers	Total
Bhagalpur	Khankitta	30	Kurpat	15	
	Rajpur	30	Lailakh	15	
	Pipara	30	Jichho	15	135
Bhanka	Kotwal	30	Gurudwar	15	
	Simaria	30	Padmpur	15	
	Kotwali	30	Babura	15	135
Grand Total	6	180	6	90	270

4.2 Methodology

Growth rate analysis

For assessing the trends in area, production and productivity of chickpea in different states and the study districts of Bhagalpur and Banka, the following growth rate formula was employed.

$$^{YT} = ab^{t}u^{t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where, ^{YT} = area/production/productivity in the year's'

a = intercept indicating Y in the base period (t = 0)

b = Regression coefficient

^{t} = Time period in years

Ut = Disturbance term for the year 't'.

Garrett's ranking technique

Each of 135 respondents selected in each district were asked to rank the preferences based on their priorities using ranks from 1 to 10. In this analysis, rank 1 means most important problem and rank 10 means least important problem. In the next stage rank assigned to each reason by each individual was converted into per cent position using the following formula:

Per cent position = 100 (Rij – 0.5) / NJ
Where,

Rij stands for rank given for the ith factor (i= 1, 2….5) by the jth individual
(j = 1, 2……., n)

Nj stands for number of factors ranked by jth individual.

Once the per cent positions were found, scores were determined for each per cent position by referring Garrett's table. Then, the scores for each problem were summed over the number of respondents who ranked that factor. In this way, the number of respondents who gave ranks arrived at total scores for each of the factors and mean scores were calculated by dividing the total score. Final overall ranking of the factors was carried out by assigning rank 1, 2, 3… etc, in the descending order of the mean scores.

5 Characteristics of chickpea growing farmers

Post stratification of sample farmers (Table 9) indicated that about 40 percent of sample farmers were of large categories followed by small (32.77%) and (27.77 %) marginal farmers in adopted

villages. However, in control villages43 percent were having large size of holdings followed by marginal farmers (37.77) and only18.88percent were having small size of holdings respectively.

Table 9.Distribution of sample farmers in studiedtwo districts in Bihar, 2012-13

Category	Bhagalpur		Banka		Pooled sample	
	Adopted	Control	Adopted	Control	Adopted	Control
Marginal	15(16.66)	30(66.66)	35(38.88)	4(8.88)	50(27.77)	34(37.77)
Small	29(32.22)	7(15.55)	30(33.33)	10(22.22)	59(32.77)	17(18.88)
Large	46(51.11)	8(17.77)	25(27.77)	31(68.88)	71(39.44)	39(43.33)
Total	90(100)	45(100)	90(100)	45(100)	180(100)	90(100)

Land owned by sample households has been classified on the basis of their uses and categorized as cultivable land (irrigated, dry) fallow land, leased in land and leased out land as below .it may further be categorized as marginal ,small and large farm according to size of holding.

Table 10.Average land holding size across farm categories (ha/household)

	Particulars	Irrig/dry	Marginal	Small	Large	Pooled
Bhagalpur	Own land	Irrig	0.69	1.36	4.02	2.19
		Dry	0.00	0.25	2.60	0.76
		Total	0.69	1.61	6.62	2.95
	Leased-in land	Irrig	0.05	0.03	0.01	0.03
		Dry	0.00	0.00	0.01	0.00
		Total	0.05	0.03	0.02	0.03
	Leased-out land	Irrig	0.00	0.00	0.09	0.04
		Dry	0.00	0.00	0.00	0.00
		Total	0.00	0.00	0.09	0.04
	Operated land	Irrig	0.74	1.39	3.95	2.22
		Dry	0.00	0.25	2.60	0.76
		Total	0.74	1.64	6.55	2.98
	Particulars	Irrig/dry	Marginal	Small	Large	Pooled
Banka	Own land	Irrig	0.58	1.45	4.35	1.64
		Dry	0.01	0.07	0.49	0.13
		Total	0.59	1.52	4.84	1.77
	Leased-in land	Irrig	0.11	0.05	0.05	0.07
		Dry	0.06	0.02	0.00	0.03
		Total	0.17	0.07	0.05	0.11
	Leased-out land	Irrig	0	0	0	0
		Dry	0	0	0	0
		Total	0	0	0	0
	Operated land	Irrig	0.69	1.49	4.4	1.71
		Dry	0.07	0.08	0.49	0.16
		Total	0.76	1.57	4.89	1.88

Pooled analysis indicated that average operational land holdings across differentcategories for Banka was about 1.88 ha/household out of that 1.71 ha was irrigated and remain were dry land. Where as in Bhagalpur it was estimated about 2.98ha/ households in which 2.22 ha was irrigated. Apart from these, on an average 0.11ha/household area was leased inland andno area was leased out to the other

farmers in Banka, where as in Bhagalpur it was estimated approximately about0.04 haof land was leased-in and leased-out to the others under study.

Socio economic profile of sample farmer indicated that100% households of sample villages headed by male. On an average, the proportion of male and female in sample households were found to be nearly 52.5 percent and 47.5 percent respectively. Further, it was observed from the table that out of total population nearly 53percent of population had agriculture as main occupation in adopted villages. However, for control villages it was 54.4 percent, followed by business and services, respectively. Based on dependency ratio, it may be said that although the majority of female workers were found engaged in household works, but a substantial proportion was also engaged in agriculture, however, their involvement in non-agriculture occupation was very limited as compared to their counterparts. Educations is considered as one of the most important indicators for development and have a look on data that levels of education for selected household head were lagged much behind as indicated by having only middle level i.e., 9.88and8.49 respectively for both of the district. One remarkable point has been observed during the survey that each household of both the district had nearly 100% of mobile ownership followed by ownership of two wheeler and television set.

Table: 11 Socio-economic profile of sample farmers in Bihar, 2011-12

	Bhagalpur		Banka		Pooled	
	A	**C**	**A**	**C**	**A**	**C**
Male headed households (%)	100.0	100.0	100.0	100.0	100.0	100.0
2Household size (No)	7.4	7.9	6.8	7.1	7.1	7.5
Male Workers(no)	2.8	2.9	2.7	3.3	2.8	3.1
Female Workers (no)	0.8	1.7	1.6	1.5	1.2	1.6
Dependency Ratio*	1.1	0.7	0.6	0.5	0.8	0.6
Age of Household head (Years)	51.0	53.0	51.0	45.0	51.0	49.0
Education Level of household head (No. of years)	10.5	8.5	9.3	8.5	9.9	8.5
Participation in local bodies (%)	0.0	0.0	0.0	0.0	0.0	0.0
Proportion belonging to forward castes (%)	62.2	0.0	0.0	4.4	31.1	2.2
Proportion belonging to religious minorities (%)	33.3	0.0	0.0	13.3	16.7	6.7
Proportion with agriculture as the main occupation (%)	51.1	42.2	54.4	66.7	52.8	54.4
Proportion with business/service as secondary occupation (%)	44.4	48.9	45.6	33.3	45.0	41.1
Ownership of two wheelers/bicycles (%)	96.7	75.5	96.0	100.0	96.3	87.8
Ownership of television sets (%)	100.0	66.0	83.0	100.0	91.5	83.0
Ownership of mobile (%)	100.0	95.5	100.0	100.0	100.0	97.8
* Dependency ratio= (Size of family-Number of workers)/Number of workers A: Adopted village; C: Control village						

Household Income by Sources: - Total household income has been derived by summing up of total farm income and total non-farm income. Total farm income comprises of income obtained from crop production, livestock, etc. While on-form income includes income derived from business, salary, remittances etc. Net household income of sample farmers in selected districts during 2011-12 by source in Rs./Year/Household has been presented below.

It may be observed that total household income on an average was worked out to be Rs.250782 for adopted villages of Bhagalpur which was found to be highest followed by adopted village of Banka district (Rs.169839). Among control villages, it was comparatively higher for Banka district than that of Bhagalpur and was estimated to be Rs.130629 and Rs.113407 respectively. Data pertaining to table indicated that majority of part of population of selected districts i.e. 53 % of total population mainly depend upon agriculture followed by business and services. Regular salaried Job figured to be the second major source of income in both the districts i.e. contribution of non-farm income was estimated about 82061 for adopted villages of Bhagalpur and Rs.82167/Year for adopted villages of Banka. Earning from business figured out to be the third most important source of income and accounted for about Rs.2277 out of Rs.130629 followed (Rs.12222) and (Rs.9967) respectively by adopted and control villages of Bhagalpur.

Table 12.Net household income of sample farmers, 2011-12 (Rs/Year)

Source of income	Bhagalpur		Banka		Pooled	
	A	C	A	C	A	C
Income from crops	92717	27544	49250	26267	70983.5	26905.5
Farm work (labor earnings)	28367	11156	15744	12311	22055.5	11733.5
Non-farm work (labor earnings)	11222	7089	7000	7667	9111	7378
Regular Farm Servant (RFS)	622	1556	0	444	311	1000
Livestock (milk and milk products selling)	3611	2844	611	21111	2111	2477.5
Income from hiring out bullocks	0	222	0	0	0	111
Income from selling sheep, goat, chicken, meat, eggs etc.	1172	729	378	4356	775	2542.5
Selling of water for agriculture purpose	0	0	0	67	0	33.5
Selling CPR (firewood, fruits, stones, and mats etc)	0	0	0	0	0	0
Selling handicrafts (specify)	0	0	0	0	0	0
Rental income (tractor, auto, sprayer, & truck etc.)	2444	133	1600	0	2022	66.5
Rent from land, building and machinery etc.	0	0	0	0	0	0
Caste occupations (specify)	0	0	0	0	0	0
Business (specify)	12222	9667	5667	23295	8944.5	16481
Regular salaried jobs (Govt./private)	82061	39956	82167	35111	82114	37533.5
Out migration	6111	5000	0	0	3055.5	2500
Remittances	0	0	0	0	0	0
Interest on savings and from money lending	0	0	0	0	0	0
Cash and kind gifts including dowry received	0	0	0	0	0	0
Pension from employer	10233	7511	7422	0	8827.5	3755.5
Government welfare/development Programs	0	0	0	0	0	0
Grand Total	2,50782	1,13407	1,69839	1,30629	2,10310.5	1,12518

Consumption expenditure of sample farmers, 2011-12 (Rs/Year)

Among Non-food items, the people of Bhagalpur district were found to have lowest expenditure in both control (42020.0**)** compared to adopted villages (55477.9) Whereas data pertaining to expenditure on total Non-food items by samples of Banka districts was comparatively higher (88688.4)in both adopted and control village(58609.1).Among food items, expenditure on cereal was found highest in control villages while the expenditure on milk and milk products, fruits and vegetables and pulses was higher in adopted villages. It may further be observed that income and expenditure of adopted villages as whole was comparatively higher than control village. The people

of adopted villages are more prosperous than control villages, which is in line with the fact that they were found to have better equity or net worth and less liability and more profit oriented.

Table13.Consumption expenditure of sample farmers, 2011-12 (Rs/Year)

Food item	Bhagalpur		Banka		pooled	
	Adopted	Control	Adopted	Control	Adopted	Control
Cereals	16949.4	18594.4	17619.7	18511.1	17284.6	18552.8
Pulses	6607.2	6343.3	7181.0	7053.8	6894.1	6698.6
Milk and Milk products	9408.3	10425.6	14180.1	6850.0	11794.2	8637.8
Edible oils	3570.0	3653.3	4913.3	4511.1	4241.7	4082.2
Non-Veg. foods	4793.3	6477.8	8110.0	1306.7	6451.7	3892.2
Fruits and vegetables	4097.6	5780.1	7026.2	1282.2	5561.9	3531.1
Others	4895.1	5441.9	6606.8	1316.9	5750.9	3379.4
Total food expenditure	**50321.0**	**56716.4**	**65637.2**	**40831.8**	**57979.1**	**48774.1**
Health	5656.7	9055.6	21450.0	14266.7	13553.3	11661.1
Education	29437.8	15315.6	40802.2	23822.2	35120.0	19568.9
Entertainment and travel	1873.3	1191.1	2184.4	1244.4	2028.9	1217.8
Clothing and shoes	9012.2	9022.2	14583.3	11500.0	11797.8	10261.1
Ceremonies	0.0	11.1	0.0	322.2	0.0	166.7
Alcohol and Cigarettes	602.2	1006.7	302.4	394.4	452.3	700.6
Cosmetics	3242.2	2760.0	3918.9	3217.8	3580.6	2988.9
Others	5653.4	3657.8	5447.1	3841.3	5550.3	3749.6
Total Non-food	**55477.9**	**42020.0**	**88688.4**	**58609.1**	**72083.2**	**50314.6**
Total expenditure	**105798.9**	**98736.4**	**154325.6**	**99440.9**	**130062.2**	**99088.6**

Source of Information for adoption of pulse technology

We tried here to analyze the source of information for adoption of new seed, fertilizer management, pest management and disease management in pulse crop, because it involves different kinds of operation which is required to be performed for getting optimum yield. However, the farmers do not carry out the operations uniformly because different farmers have different level of technical knowledge and resources in possession and have different needs. Therefore adopting these practices may invariably be different from farmer to farmer. To analyze the sources of information for different purpose, the proportion of sample farmers who adopted a particular operation by getting knowledge from above mentioned operations has been worked out and presented below

Table 14.Sources of information to sample farmers in 2011-12								
Sources of information	New seed/cultivar		Fertilizer management		Pest management		Disease management	
	A	**C**	**A**	**C**	**A**	**C**	**A**	**C**
Input-dealers	3	2	3	3	4	3	4	3
Research station	2	5	2	2	2	1	2	1
Extension staff	6	7	4	7	3	4	3	4
T.V/Radio	5	4	6	4	5	5	5	5
Magazines/News paper	7	6	7	6	7	7	6	7
Fellow farmers	1	1	1	1	1	2	1	2
Friends/relatives	4	3	5	5	6	6	6	6

Note: 1 means highest importance and larger the number least important it is in terms of farmers consultation for the source of information of cultivars and agriculturalpractices related information.

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As shown in table 14, despite of the KVK research station being located nearby from the farmers' settlement, The surveyed farmers have not given top priority to the research station for agricultural related information and chickpeas cultivar choices; but they have given top priority to fellow farmers (highest rank), followed by friend and relatives (2nd highest rank), and then to input dealers (3rdrank).

Table 15. Sources of information in Banka district, 2011-12 (Wt.scale)

Sources of information	New seed/cultivar		Fertilizer management		Pest management		Disease management	
	A	C	A	C	A	C	A	C
Input-dealers	2	4	3	4	4	4	4	4
Research station	4	2	4	3	3	2	3	1
Extension staff	3	3	2	2	2	3	2	3
T.V/Radio	6	6		6	6	6	6	5
Magazines/News paper	7	7	6		5	5	5	
Fellow farmers	1	1	1	1	1	1	1	2
Friends/relatives	5	5	5	5	7		7	

For Banka, almost similar pattern had been followed as fellow farmers has been ranked 1st followed by research station and extension staff for New seed except control village for pest management, they were found to give top priority to the research station.

It may be concluded that majority of farmer's rely on fellow farmers for getting any information or package of practices for raising the crop. This finding clearly indicates that proportion of farmers approaching research station to meet their seed requirement was quite low for chickpea production, which also indicates the poor extension service in this respect.

Crop yield of chickpea

Productivity of chickpea by varieties in sample districts during the year 2011-12 kg/ha has been presented in the following table.

Table: 16. Productivity of Chickpea by varieties in Bihar sample, 2011-12 (kgper ha)

Variety	Bhagalpur		Banka		Pooled Sample	
	Adopted	Control	Adopted	Control	Adopted	Control
Deshla Roon	732.77	741.00	946.83	900.35	848.03	890.70
Desla Plain	668.66	626.32	776.09	638.08	702.53	627.11
JG 14	790.40		1042.34		1000.35	
KAK 2	988.00		806.87		832.74	
Radha	864.50	494.00		671.84	1010.45	630.80
Subhara	839.80			370.50	790.40	370.50
Vaibhav	699.83				699.83	

Economic analysis of chickpea cultivation

An economic analysis of an activity provides rich information on farmers' intensions and incentives pursued for using particular activity. Economic analysis of cultivation of crops thus provides vital information on why farmers grow particular crop and which crop is most remunerative in a location. A summary version of information pertaining to cost of cultivation and input output ratio associated with growing chickpea at different locations has been presented in Table 17 below. The net return obtained from chickpea was estimated as Rs 6000 to 20,000 /ha in the sample surveyed village among the sample farmers. This indicates that the comparative advantage from chickpea was better than many of the competing crop like wheat, as indicated in table (returns from different crops), especially with the environment of in adequate irrigated areas. By and large, pulses crop are more remunerative crop for Banka rather than Bhagalpur, however there is no distinct different across the farmers. Due to low crop yield, and even some of the farmers from control village growing improved cultivar of chickpeas due to farmers to farmers transfer of knowledge, and seeds in the area.

Table 17.Economic costs for growing cultivar types in the sample farms, 2011-12 (Rs per ha)

Factors					Sample Average (Pool Data)		Average of all 4 sample (Adopter + Control)
	Bhagalpur District		Banka District				
	A 1	C1	A2	C2	Adopter	Control	All Sample
1. Total production cost/ha	17042	14132	11721	14774	14382	14453	14417
2. Grain yield (kg/ha)	978	596	595	1006	787	801	794
3. Grain price/kg	30	30	30	30	30	30	30
4. **Value of Grain**	29340	17880	17850	30180	23595	24030	23813
5. Fodder yield (kg/ha)	978	596	595	1006	787	801	794
6.Fodder price/kg	5	5	5	5	5	5	5
7 Value of fodder	4890	2980	2975	5030	3933	4005	3969
8. Gross Income per ha	34230	20860	20825	35210	27528	28035	27781
9. Net profit per hectare	17188	6728	9104	20436	13146	13582	13364
10. Benefit cost raio	1.72	1.27	1.52	2.04	1.62	1.65	1.64

Overall, when the benefits from all of the farmers' types and location are combined, then the overall benefit and cost ratio of chickpeas in the survey site is 1.64. This is fairly higer than many of other crops cultivated in the areas. Detailed results are in Tables 17.

8 Constrains and prospects of chickpea production

Many problems or constraints were observed on sample farms, which were pooled into fallowing categories namely, low yield, pest and disease, long duration, small grain size, lack of technical knowledge, low market price or pulse production being not profitable etc. The constraints involved in chickpea production were identified and ranked according to weighted mean scale or in form of proportion of farmers who given priority for that observed occurrence of the problem on their farm and the results have been presented below.

Table 18. Major Constraints among cultivars (Wt. Scale)

Constraints	Bhagalpur		Banka	
	Local(d.p)	Local(d.r)	Local	Improved
Low yield	1st		1st	2nd
High pod borer incidence	2nd	1st	2nd	1st
High disease incidence		3rd	3rd	3rd
Long duration				4th
Small grain size	5th		4th	
Not attractive colour	4th	2nd		
Poor taste		5th		
Low recovery of dal (%)				
Low market price	3th			
Not fit into cropping system		4th	5th	
Poor fodder quality				
Susceptible to storage pest				5th

The findings clearly indicate that major constraints among cultivar in Bhagalpur for local variety was low yield followed by high pod borer incidence, low market price, having no attractive color and small grain size was ranked 1st, 2nd 3rd, 4th and 5th respectively. As far as the improved varieties were concerned high pod borer incidence followed by not having attractive color, High disease incidence, not fitting into cropping system and poor taste were given the 1st 2nd, 3rd, 4th and 5th accordingly.

In Banka district, the major constrains in order of importance were low yield, high pod borer incidence, high disease incidence, small grain size and low recovery of dhal percentage as 1st, 2nd, 3rd, and 5th rank respectively for local variety and high pod borer incidence followed by low yield, high disease incidence, long duration& not fitting into cropping system as 1st, 2nd, 3rd, 4th, and 5th accordingly for improved variety by the respondents.

Thus it may be concluded that major constraints among cultivar was the pest and disease for improved variety and Low yield was the main problem for local varieties of chickpea production among selected farmers of both districts in Bihar.

9 Conclusions and Implications

Chickpea is one of the major pulse crops in Bihar. The area under chickpea has declined from 2.45 lakh hectare in 1975-76 to 0.56 lakh hectare in 2011-12, although productivity has increased from 550 kg/ha to 1000 kg/ha during the same period. Decline in area of chickpea was mainly due to insecure harvest of crop in isolated pockets due to social factor. Heavy losses in production of chickpea due to insect's infestation mainly pod borer, socio-economic constraints, problems of market, lack of improved varieties etc. Among variety distributed to the farmers JG 14, KAK 2 and Subhra are most acceptable variety in the farmer's field in both of the districts in Bihar. However poor germination, non-suitability into cropping pattern, post-harvest losses due to rat attack, etc., are some of the major farmers' level problems which hinders them for expansion of its crop acreages.

The productivity of improved variety ranged in between 850 kg to 1000kg/ha in selected district under study. However the cost of cultivation/ha has been estimated Rs. 18280to 19200/ha. Relative importance of chickpea in the total cropped area has also been declined. However, profitability of chickpea is comparatively more than others Rabi crop. Regarding local variety, one of the major setbacks is that the farmer from 20 to 25 years has not replaced it. Most preferred traits for production consumption and marketing in Bihar is that those varieties which gives higher yield ranked 1st for production and fetching high price along with having high demand and better taste with good keeping quality ranked accordingly for consumption and marketing purpose. Local variety is the only reliable for consumption and production purpose.

Major constraints for growing chickpea in Bihar are unavailability of suitable HYV of crop, erratic rainfall causes moisture stress in the post monsoon season, increasing incidence of disease and insect infestation, etc. Recently, consumption of chickpeas has gone up but this has not been reflected in the wholesale prices in the local communities. To increase area and production of chickpea in the study locations in Bihar, region specific approaches and prioritization may need be give, and chickpea adoption needs to be considered within the farming systems of the crop choices of the farmers. Since, recently the rice and wheat crop acreage have been in increasing trend, and majority of farmers opt for cultivation of wheat in the post-monsoon season after rice; instead of chickpeas and other crops, especially when the irrigation is available at assured source. This is due to relatively low level of crop yield of chickpeas than wheat and other crops.

Policy implications

Following policy recommendations have emerged out of the empirical analyses carried out above.

(i) Replacement of traditionally grown varieties with high yielding varieties.
(ii) Inclusion of short duration varieties of chickpea as catch crop.
(iii) Improving market information system and infrastructure.
(iv) Linking MSP to market price can bridge the gap between demand and supply.
(v) Co-ordination of research extension and farmers to encourage farmer's participatory research etc.

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